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13. ABSTRACT *(Maximum 200 words)*

The new facility makes possible the analysis and processing of high current density oxide cathodes and the study of pulse shortening in the output circuits of microwave tubes.
The equipment requested consists of an instrument to measure cathode activity, two surface analysis instruments and miscellaneous vacuum components for cathode work. For pulse shortening research, and x-ray imaging system to study dark current in a high gradient test cavity.

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STANFORD UNIVERSITY
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July 26, 1999

Dr. Robert Barker
Directorate of Physics & Electronics
AFOSR/NE
801 North Randolph St., Rm 732
Arlington, VA 22203-1977

Dear Dr. Barker,

Enclosed is the **final technical report** for the 1996 DURIP contract # F49620-96-1-0375. Stanford sincerely appreciates the equipment funds provided by AFOSR. The equipment listed in the technical report will contribute significantly to our understanding of RF breakdown, thermionic cathodes, and high power W-band klystrons.

Sincerely,

Robert Siemann
Department Head
ARDB

Final Technical Report
Defense University Instrumentation Research Program

Grant Number F49620-96-1-0375

A Facility to Study the Basic Power-Limiting Mechanisms In High Power Microwave Sources

Sponsored by
Air Force Office of Scientific Research/NE

Program Manager
Dr Robert J. Barker
AFOSR/NE
801 North Randolph St., Rm. 732
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July 21, 1999

Final Technical Report

The equipment purchased with the 1996 DURIP contract # F49620-96-1-0375 is listed below.

Equipment and Vendor	**Cost**
Miram Curve Generator ETM 35451 Dumbarton Court Newark, CA 94560	$161,775
X-ray CCD camera system Princeton Instruments Inc. 3660 Quakerbridge Road Trenton, NJ 08619	

The Princeton CCD camera was unable to produce x-ray images from a single pulse even at very high x-ray fluxes. The camera was returned and the cost was refunded minus a restocking charge of 25%. Camera cost was $45,122. The cost to the program was $13,806. The AMAX Computer that came with the camera was retained because it was used to provide control and data acquisition for the RGA and the other GPIB controlled instruments used in the experiment.

AMAX Computer Princeton Instruments Inc. 3660 Quakerbridge Road Trenton, NJ 08619	$2,165
Residual Gas Analyzer Stanford Research Systems 1290 D Reamwood Ave. Sunnyvale, CA 94089	$8,173
Video camera, VCR, lenses ESSCO 1699 Annie St. Daly City, CA 94015	$ 1,260
HP 84815 peak power sensor Hewlett Packard	$ 2,003

Dell Precision Workstations $32,969
Dell Computer Corporation
One Dell Way
Round Rock, Texas 78682

The above items total cost is $222,151. There is some $1396 in uncapitalized costs that brings the total charges to the DURIP account to $223,547. The difference between this and the grant amount of $229,267 has been reported to AFOSR for deobligation.

The Miram Curve Generator (MCG) is a specialized high voltage pulsed power supply that can supply 10 microsecond pulses at 30 kV and 10 A with a pulse repetition frequency of up to 60 Hz. The MCG is used to test the cathodes produced in the plasma deposited oxide cathode research program. The test vehicles operate at a microperveance of 2 and have a 0.1 cm^2 cathode area. Thus the MCG can be used to evaluate oxide cathodes up to 100 A/cm^2.

The MCG has also been used to evaluate the optics of the electron gun for the W-band klystron program. Both the beam optics and the beam transport through a PPM stack have been evaluated using the MCG.

The Princeton Instruments CCD camera was to be used in imaging the x-ray emission from the RF breakdown experiments being conducted at Stanford's Linear Accelerator Center. The goal of the experiment was to use the x-ray sensitive camera to image the emission surface on a pulse by pulse basis and identify the emission sites that trigger breakdown. Unfortunately, the sensitivity of the x-ray detection in the camera was insufficient to resolve the emission sites in a single pulse. A long term exposure would give an average of the x-ray emission over many pulses but individual sites could not be resolved. Because of this the camera was returned to Princeton Instruments.

The Residual Gas Analyzer is being used in the RF breakdown experiments to identify the gases produced by high electric fields on copper surfaces both before and after RF breakdown events. Stanford's experiments on RF breakdown have provided significant support to the hypothesis that field enhancement from surface plasmas leads to RF breakdown. The current experiment has improved the background pressure in the breakdown cavity by two orders of magnitude and has resulted in RF breakdown threshold levels that are 50% higher than previously achieved. The next experiment will use a controlled leak valve to vary the pressure in the breakdown cavity and determine the variation of breakdown threshold level with pressure for several different gas species. The RGA will be used to both monitor pressure and determine the gas evolution during processing.

The video camera, VCR, and lenses were used to obtain visible light images of RF breakdown events when the X-ray camera was found to be inadequate. Pictures obtained

with the video camera show individual breakdown events that vary in location from pulse to pulse.

The Hewlett Packard peak power sensor is also used in the RF breakdown experiment to obtain RF power measurements. The amount of power transmitted through the cavity is used to determine the peak field levels during the experiment.

The Dell workstations are used for modeling and simulation of klystrons using the MAGIC computer code from MRC. W-band and L-band simulations are carried out to evaluate the performance potential of the W-band klystrino program and the L-band GMBK program. The workstations are also being used to model the generation and development of surface plasmas due to electron and X-ray desorption of surface gases.